Presentation Abstracts

for the

2022 NASA

Cost and Schedule

Symposium

April 26- 28, 2022

Hosted near Kennedy Space Center

Cocoa Beach, FL

2022 Abstract Collection

The Strategic Investments Division would like to welcome you to the 2022 NASA Cost and Schedule Symposium. This document contains the names of the authors and abstracts for the presentations that will be given this year. In the Symposium Agenda you will notice that there is a unique ID number mapped to each presentation. These same ID numbers can be used, within this document, to find the presentation abstract that you are interested in.

This year, with a cadre of excellent presentations and an awards banquet full of worthy nominations, the NASA Cost and Schedule Symposium will be a full and eventful three days!

Contents

01_ Dealing with Missing Data – The Art and Science of Imputation

Authors: Kimberly Roye, Dustin Hilton, Christian Smart

Presenters: Christian Smart

Abstract: Missing data is a common phenomenon most analysts have experienced. Even when a dataset includes a significant number of data points, many of the variables of interest will have missing values. The most prevalent method for dealing with such data points is to leave them out of analysis. This method is not ideal for multiple reasons. One is that unless the data are missing completely at random, leaving out data points with missing values will bias the results of analysis. A second is that it leads to smaller data sets used for analysis. Deleting data points has been demonstrated through numerous empirical studies to be one of the worst methods for dealing with missing data.

Most of the time in defense and aerospace applications datasets are already small. Not using all the available data means that analyses are based on even smaller datasets, which reduces the power of the analysis and makes them more prone to overfitting. In this paper, we discuss the use of imputation to overcome the issue of missing data. Imputation is a proven statistical technique to fill in missing data points, allowing analysts to use all the available data. We discuss two current best practice techniques – Expectation Maximization (EM) and Multiple Imputation via Chained Equations (MICE) – and discuss the pros and cons of each. We discuss the limitations of imputation and the best situations for its application.

03_ NASA Programmatic Performance

Authors: Kevin Gilligan

Presenters: Kevin Gilligan

Abstract: NASA is better than ever before in cost and schedule estimation, yet challenges remain in holding costs and schedules to our external agency baseline commitments. This presentation will provide an overview of cost and schedule variance against baselines (and re-baselines) for the NASA major project portfolio, summarize NASA's continued presence on the Government Accountability Office's High Risk List, and describe some of the efforts NASA is undertaking to improve its acquisition management practices.

04_Chief Program Management Officer Overview

Authors: David Mitchell

Presenters: David Mitchell

Abstract: NASA created the Chief Program Management Officer in January 2022. This role is responsible for strengthening the agency's oversight, management, and implementation of program management policies, processes, and best practices. This presentation will provide a brief overview of the role.

05_Earned Value Management, Year in Review

Authors: Jon Fleming

Presenters: Jon Fleming

Abstract: This presentation will highlight some of the great progressions and accomplishments made in the past year within the NASA Earned Value Management community. This includes NPR 7120.5F EVM Language Changes, Integrated Baseline Reviews (IBRs), NASA-led EVMS Compliance Review Update, other Major Accomplishments, as well as updates to the NASA EVM Website.

06_ COMPACT KNN V2: Analogy-Based Cost Estimation Model for CubeSats

Authors: Melissa Hooke

Presenters: Melissa Hooke

Abstract: The CubeSat Or Microsat Probabilistic and Analogies Cost Tool, or COMPACT, is a NASA Headquarters funded effort to fill the gap in cost estimating capabilities for CubeSats, as well as other microsat spacecraft. The COMPACT team has focused mainly on CubeSats to date, and has collected technical, programmatic and cost data on dozens of flown CubeSats missions led by NASA, research labs, and universities. In late 2019, the team released the first tool prototype which uses a non-parametric regression technique, k-Nearest Neighbors (KNN), on actual data from historical CubeSat missions to produce early ballpark analogy-based cost estimates for new CubeSat concepts. Since the KNN prototype was first released, the COMPACT team has normalized 17 new missions to be added to the model in COMPACT V2. COMPACT V2 also features changes to the KNN tool algorithm including the introduction of Principal Component Analysis (PCA) to the model development process and changes to the input parameters which have made the analogy results more intuitive and have improved model performance. This presentation will describe the current COMPACT KNN dataset, improvements made to the model in COMPACT V2, an assessment of current model performance, and a forward look at COMPACT's planned future enhancements.

07_ Schedule Analysis for Dummies

Authors: Glenn Butts, John Dotson

Presenters: Glenn Butts

Abstract: NASA has numerous skilled schedule analysts at the agency, and extremely powerful analysis tools like Acumen FUSE. However, unfortunately management routinely doesn't understand what these analysts are telling them. Without understanding what a health check is, what BEI or HMI is and why they should care are key sources project schedule failures.

"I see all this data and I see all these reports, and I hear you, but I don't understand our status." Mark S. Geyer, the Orion project manager

Management just wants to know if the project is on track or not. It is helpful if you can show them some intuitive analysis that makes sense, it helps more if it is easy to do. We will show some quick checks that can be done by non-schedule experts that is helpful to analysts and management alike.

08_ A Deep look into Optimistic Cognitive Bias based on a NASA's STEM 4th Grade Activity

Authors: Steve Sterk

Presenters: Steve Sterk

Abstract: This paper is a direct result based on independent research being conducted by Steve A. Sterk who works in the Program Planning and Control (PPC) Branch at NASA Armstrong Flight Research Center. It is a believed optimistic cognitive bias, is the number one problem while developing cost and schedule estimates and thus digging into human behavioral, a heuristic technique in completing the task at hand. This presentation will include 1.) How people think, 2.) the start of an Optimistic Cognitive Bias data base, will lightly discuss; machine learning, iBOTs, Power-Bi, Fit Bit Apps, artificial intelligence for future cost and schedule estimates 3.) a Roadmap which will lead the Audience, how to prevent "why" Projects and Programs overrun their baseline cost and schedule estimates, thus thinking like a neuroscientist.

10_ Do Firm-Fixed Price Contracts Curb Cost Growth?

Authors: Leah Sobel, Elliot Tibor

Presenters: Leah Sobel, Elliot Tibor

Abstract: There are many types of contracts used by NASA for science missions to procure spacecraft, this study focuses on two main categories: Cost-Plus (CP) contracts and Firm-Fixed Price (FFP) contracts. When CP contracts are used, NASA agrees to cover the actual expenses of the project which includes the planned original cost and any additional labor or material costs incurred to complete the work. The CP contract mechanism is ideally implemented when NASA's requirements are not well-defined, and the likelihood of a modification to the scope of the project is high. When FFP contracts are used, NASA agrees to cover a non-variable cost and will not pay for any additional labor or material costs incurred to complete the work. The FFP contract mechanism is ideally implemented when NASA's requirements are well-defined, costs can be predicted, and the contractor has experience in manufacturing a product that fulfills the requirements. This study investigates historical cost growth of spacecraft for a variety of NASA science missions launched over the last 20 years, by comparing historical cost growth of CP and FFP spacecraft from contract start to delivery. Additionally, this study will also examine the potential causes of cost growth on FFP contracts, including schedule delays, requirement changes, the addition of new scope after the contract was signed, and mistakenly formulating a basis of estimate by assuming high heritage to a previous spacecraft. The results of this study will provide guidelines and lessons learned to help NASA and other government agencies determine when an FFP contract can be used effectively and efficiently.

11_ Early Project Formulation and Development Success: Does NASA Sink Projects Even Before They Start?

Authors: Ron Ray

Presenters: Ron Ray

Abstract: Multiple NASA efforts have and continue to investigate why some projects are development cost successes and others overrun, but the results have been less than satisfying. SID studies have examined how various factors are associated with development success, both in isolation and aggregate. The consensus result is that while some factors or combinations of factors show minor correlations, there is a tremendous range of variance that has yet to be explained.

This presentation briefly summarizes "Factor" or "Characteristic" studies, then focuses on how the very early formulation of a project as it is proposed for incorporation into NASA budget requests as a new start may affect eventual project cost performance. The time period of interest predates Agency Baseline Commitments (ABCs) and Management Agreements for schedule and cost, and often predates formal Phase A effort on a possible project. This analysis looks at whether early formulation decisions, leading up to NASA budget submissions, build a budgetary "box" around a proposed project that the project cannot escape from. Most SID studies on cost performance use ABC's as the starting point for cost consistent with external reporting practices to Congress and the Government Accountability Office. Since this study looks at the effects of early formulation, it tracks costs from the earliest proposal that gets incorporated into a budget request, rather than from the ABC's.

Note to selection committee: The primary analysis is "Early Project Formulation and Development Success: Does NASA Sink Projects Even Before They Start?", from SID Insights Volume 10. Other Insights summarized include "Contribution of Individual Project Element Cost Increases to Total Project Cost Increases", also from Volume 10, Vendor Performance from upcoming Volume 11, and "Lack of Deterministic Factors Influencing Project Development Performance" from Volume 3, and I expect to highlight some other individual factor analyses from other analysts.

14_ Integration of NASA Cost Tools to Estimate Mission Concept Costs

Authors: Natalie J. Weckesser

Presenters: Natalie J. Weckesser

Abstract: Compass, a concurrent engineering team at NASA Glenn Research Center, designed a mission in which an orbiter and several landers use a trajectory to Venus and carry out a number of years of primary science operations. Compass desired mission life-cycle cost estimates as part of the study's findings. Several unique hardware elements needed to be estimated, in addition to element-level wraps, mission-level wraps, software costs, and Phase E mission operations and science costs. To build a comprehensive estimate, many estimating tools were required, and their outputs integrated into a cohesive model. This paper will detail the estimating process, including the inputs solicited from the design team, the NASA tools used and their application, the approach for creating a cohesive model, and the greatest barriers to doing so.

15_TruePlanning Space Missions Catalog

Authors: Christopher Price, Mark Jacobs, Shawn Hayes

Presenters: Christopher Price

Abstract: NASA continually strives to improve cost estimation for the highly advanced technology flown on planetary as well as earth orbiting space missions. Over the years it has been proven that parametric cost models are a desired way to obtain accurate estimates. Still there is room for improvement. This paper will discuss two of the latest and best methods for obtaining accurate cost estimates using best-of-breed model-based cost engineering techniques.

This paper / presentation will address two relatively new methods to improve the accuracy of space missions cost estimates: TruePlanning Hardware Equipment Types and a relatively new Space Missions Catalog, with emphasis on the later. Both methods include a variety (up to 119) space specific equipment types, and the Space Missions catalog also includes novel specific models for electric propulsion, ion thrusters, lasers, parachutes, radar altimeters, and thermal protection. This paper / presentation will include two case studies (one earth orbiting and one planetary mission) featuring many of the above equipment types and unique cost models. A validation study of the results of these case studies will also be included.

16_ Schedule Confidence and Acceleration using Deltek Acumen Fuse, Risk, and 360

Authors: David Rose, Philip Ashtianie

Presenters: David Rose, Philip Ashtianie

Abstract: Stakeholders often challenge project teams to verify the quality of their schedules, brief the schedule confidence level, and accelerate the schedule. Project teams need robust tools and techniques that support the responses to the stakeholder requests and help the project managers examine and identify schedule areas that may have opportunities for acceleration. Recently, Cobec Consulting acquired Deltek Acumen licenses after witnessing the tangible benefits NASA realized using Fuse by participating in the regular NASA SCoPe meetings. This paper describes how Cobec Consulting is leveraging Deltek Acumen, Fuse, Risk, and 360 to present high quality, high confidence schedules to our FAA stakeholders and leverage 360 to explore opportunities for project plan acceleration.

The authors of this paper will illustrate:

> 1) How an FAA Joint Resource Council Final Investment Decision schedule is prepared for analysis using Deltek Acumen.

> 2) How the scheduling team uses Fuse to prepare the schedules for handoff to the FAA Investment Planning and Analysis Team for a schedule quality assessment.

> 3) How 360 is used to identify and process key "challenge" milestones through 360

> 4) How 360 outputs and generated scenarios are examined to review driving activities

> 5) discuss how the outputs of the 360 analysis assisted in gaining stakeholder alignment to re-examine task durations, look for areas of efficiency and synergy, and pull in the schedule to help meet program goals

17_ Imaging X-ray Polarimetry Explorer (IXPE) Cost Trace

Authors: Billy Carson

Presenters: Billy Carson

Abstract: The MSFC Engineering Cost Office performed cost estimates and analyses for the Imaging X-ray Polarimetry Explorer (IXPE) proposal and Concept Study Report (CSR). The ECO also provided support to IXPE for various milestone reviews. Now that IXPE is successfully in orbit, the ECO wanted to trace our costs estimates through the project lifecycle and compare those estimates to the projects costs via information found in the CADRes and obtain from the project office.

Information discussed in the paper:

- Brief history of IXPE design changes over time,
- Comparison of estimates over time,
- Project costs over time as recorded in CADRe,
- Discussion of the delta cost from early estimate to costs at launch.

18_ Integration of Model-Based Systems Engineering and Programmatic Analysis Tools

Authors: Louis Fussell

Presenters: Louis Fussell

Abstract: Model-based systems engineering (MBSE) is an alternative to the traditional document-based systems engineering approach. NASA is a leading proponent of MBSE, and the approach was applied to several NASA projects. In order to eliminate errors and inefficiencies from replicating design information, the MBSE community is developing interfaces between MBSE tools and configuration management tools, computer aided design tools, spreadsheets, and other discipline-specific analysis tools. This holds true for programmatic analysis tools as well. The paper provides an overview of the application of MBSE at NASA and efforts to integrate MBSE tools with programmatic analysis tools. A technical demonstration of this utility is provided which integrates Vitech's GENESYS MBSE tool with NASA's tools for parametric cost and schedule estimation and joint confidence level analysis. The intent is to bring awareness of this emerging capability to NASA's programmatic community.

19_ NNSA's Early-Stage Cost Estimating Tools for Strategic Planning

Authors: Charles Loelius, William Todd

Presenters: Charles Loelius, William Todd

Abstract: The Office of Program Analysis and Evaluation (PA&E) within the National Nuclear Security Administration's (NNSA) is charged with leading programmatic cost estimating and associated analytical support for nuclear weapon-related activities and capital acquisition projects throughout the federal budgeting process. PA&E has developed a suite of models which support early-stage cost estimating and planning within the NNSA. The estimates generated with this methodology are updated and published annually in NNSA's 25-year strategic planning document called the Stockpile Stewardship and Management Plan (SSMP). In particular, PA&E publishes cost estimates for upcoming major modernizations of nuclear weapon systems and new major infrastructure acquisition which account for a significant portion of the NNSA's budget. PA&E uses two suites of tools to estimate these projects, the Major Modernization Model and the Cost, Schedule, and Phasing Estimating Relationships for Construction (CSPER-C) model.

NNSA's PA&E develops time-phased planning estimates for modernization of the United States' nuclear stockpile systems over the next twenty-five years using the Major Modernization Model. Over the past decade, the United States has begun planning and executing the refurbishment of existing systems and the development of new weapon systems. PA&E estimates both the cost of research, development testing and evaluation (RDT&E)

for the systems and their production. Development costs are estimated using complexity factors derived from comparisons with prior modernizations, along with a modified Rayleigh distribution informed by historic cost actuals. Production costs are based on anticipated production schedules and quantities, along with a variation of the Crawford model for learning curves. The Major Modernization Model produces s-curves developed by using Monte-Carlo methods to account for the distribution of complexity factors. Critically, these early-stage estimates require only high-level inputs that can be easily tuned to perform what-if analyses.

NNSA's PA&E uses the CSPER-C model to produce defensible early-stage cost estimates for infrastructure across its eight laboratories, plants, and sites to ensure that adequate resources are available to complete its recapitalization plans. The nuclear security enterprise has inherited its infrastructure from the Manhattan project and the cold war, so that many of its facilities need replacement. PA&E uses a parametric cost estimating relationship developed from historic NNSA data to estimate the costs of those replacement facilities. The CSPER-C model uses the gross square footage, facility hazard classification, and complexity of programmatic equipment as parameters. CSPER-C accounts for technical uncertainty in the range of project inputs and cost uncertainty derived from historic cost actuals. Like the Major Modernization Model, CSPER-C uses Monte Carlo simulation to produce an "s-curve" distribution for each project. The schedule estimating relationship is derived from historic schedule durations and is driven by the cost of the project and whether or not the project involves nuclear hazards. The phasing estimating relationship is derived from historic

execution of NNSA projects and allows for the development of execution and budget profiles. Like the Major Modernization model, the key to these relationships is that the inputs are high-level and so can estimate projects even at a very low level of definition.

20_ Alternative Risk Measures for Determining Program Contingency

Authors: Louis Fussell

Presenters: Louis Fussell

Abstract: In 2005, NASA began requiring projects to statistically sum the cost of project components and the duration of their schedules to determine confidence levels for total project cost and duration jointly. This sum is typically accomplished by means of a Monte Carlo simulation executed with a cost-loaded schedule model augmented with probabilistic distributions assigned to costs and durations based on project risks and estimate uncertainties. NASA policy requires that project managers reserve budget equal to a 50% joint confidence level and that the managing directorate hold reserve to a 70% confidence level, with some exception. The 50% and 70% joint confidence levels are quartile risk measures referred to as Value-at-Risk (VaR) in risk management literature. This paper will discuss the drawbacks of VaR risk measures and propose the use of alternative risk measures, namely the mean and expected shortfall, for determining project reserve levels. Monte Carlo simulations for several NASA projects were executed and a comparison of 50% and 70% VaR, mean, and expected shortfall risk measures is presented.

21_ Discrete Event Simulation as a Tool for Cost Estimating

Authors: Zachary Matheson, Thomas Cook, Gabe Sandler, Charles Loelius, William Todd

Presenters: Julie Anderson, Zach Matheson

Abstract: The Office of Program Analysis and Evaluation (PA&E) within the National Nuclear Security Administration (NNSA) is charged with leading programmatic cost estimating and providing associated analytical support throughout the federal budgeting process. Several NNSA capabilities require the construction of production facilities to manufacture components that are not commercially available. To prepare early-stage cost estimates for budget planning, PA&E developed discrete event simulation models of production processes to estimate equipment required to manufacture components at specified production rates. This analysis has been used to estimate equipment, facility size, and staffing requirements for a given production capability, informing a defensible cost estimate.

22_ Programming Analysis & Evaluation (PA&E) Analysis of Alternatives (AoA) Methodology

Authors: Christopher Massey, Charles Loelius

Presenters: Cash Fitzpatrick and Christine Suhr

Abstract: Analysis of Alternatives (AoA) are important and complex studies that are conducted throughout the federal government in order to evaluate material and non-material solutions to meet mission need and future requirements. The goal of an AoA is to better define and understand the solution space to address mission gaps and allow for an understanding of the cost, schedule, risk, and effectiveness trade-offs between alternatives with the goal of allowing leadership to make a data-driven, unbiased, and defensible down-select decision. In many government organizations, AoAs are conducted by various support offices with specialties in cost estimating, schedule estimating, and systems engineering/requirements development. This often leads to stove-piped execution of cost, schedule, risk, and effectiveness analysis which can lead to differing baseline assumptions that may drive inconsistencies in analysis results.

The Department of Energy's National Nuclear Security Administration (DOE NNSA) conducts AoAs for their major capital acquisition projects (>$20M) and has consolidated the functions of leading and conducting analysis for all AoAs for major capital acquisition projects under the Office of Management And Budget's Programming, Analysis, and Evaluation (PA&E) group. The consolidation of responsibilities for AoAs under the analytics group within the NNSA has allowed for more integrated and informative analysis which has improved both the resultant analysis and the final alternative down selections for major capital projects. This presentation is focused on highlighting the management processes, analytical approaches, and lessons learned experienced by PA&E in order to help improve AoA policy, approaches, and results for other organizations.

23_ NASA's EVMS Surveillance

Authors: Briannah Smith, Kristen Kehrer

Presenters: Briannah Smith, Kristen Kehrer

Abstract: An EVM system is the management control system that integrates a program's work scope, schedule, and cost parameters for optimum program planning and control. To make sure the EVM system is working properly and producing data that is valid, accurate and timely, NASA implemented routine surveillance.

Begun as a product of a GAO recommendation, NASA funded EVMS surveillance in 2019 and hasn't looked back since. Leveraging the surveillance process and practices of the Defense Contract Management Agency (DCMA), NASA began by deploying surveillance at suppliers, APL, JPL and SwRI, and then expanded in-house at GSFC, JSC, KSC and MSFC. As of FY21Q4, 689 individual tests have been run on 19 projects.

This presentation will describe how the EVMS surveillance approach was developed and implemented. It will describe the various metrics utilized to test system health, the data collected to enable analysis, and the various tools used to support surveillance. The presentation will also discuss how projects are selected for surveillance and the various surveillance outcomes. High level surveillance results and trends will be shared that as well as some of the successes achieved.

25_ The NASA SMEX Myth

Authors: Kathy Kha, Salley Whitley

Presenters: Kathy Kha

Abstract: With a cost cap not to exceed ~$150M, NASA's SMEX program aims to deliver frequent world-class science opportunities at a low cost. While this is theoretically enticing, it is nearly impossible for awarded projects to deliver to their proposed cost and schedule, especially with increased requirements once awarded. The myth of a SMEX program recalls the old days of the failed philosophy "faster, better, cheaper." Our research will examine the science, cost, and schedule performance of NASA's series of SMEX missions.

26_ Class D Missions PM/SE/MA

Authors: TBD

Presenters: Ben Clare, Sally Whitley

Abstract: NASA Class D missions are becoming increasingly prevalent, with the promises of lower mission costs being a big motivator. But how are these missions so low cost? The answer lies in the amount of risk these missions are willing to take on. NASA's Class D tailoring and streamlining memorandum is held up as the guideline for how to modify program management, systems engineering and mission assurance (PM/SE/MA) requirements to meet Class D standards. It is a common cost estimating heuristic to use a wrap factor on hardware costs to estimate PM/SE/MA costs as it's understood that these costs will then fluctuate with the size of the mission. However, with Class D missions, this method needs to be reevaluated since the wrap factors typically used include many functions that are not applicable to Class D missions, such as EVM. In this presentation, we will go through reexamining Class D mission data available in CADRe and developing an appropriate PM/SE/MA wrap factor.

27_ NASA PCEC Updates for 2022

Authors: Brian Alford, Shawn Hayes, Mark Jacobs, Richard Webb

Presenters: Brian Alford, Shawn Hayes, Mark Jacobs

Abstract: The release of the Project Cost Estimating Capability (PCEC) v2.3 last year brought about the inclusion of data from several recently launched missions and a completely new set of CERs, particularly for estimating robotic science missions. This year's presentation will primarily focus on two topics currently under investigation by the PCEC team: challenges normalizing the mission data to isolate COVID-19 impacts and additional enhancements to the Robotic Spacecraft CER development process.

Impacts from COVID-19 have been experienced by all NASA robotic science missions in development between March 2020 and March 2022. The level of impact can vary depending on where each project was in its development cycle, use of contractors/subcontractors, international contributions, launch date flexibility, and many organization-specific constraints experienced during this 2-year time-period. Although data from 25 projects shows significant variability, the impact appears to be greatest for missions scheduled to launch in 2023. This data can be used to identify any correlations between COVID-related cost growth and various project characteristics. To better understand how to treat these cost increases for future mission cost modeling has multiple challenges to address. These include inconsistencies in project tracking of COVID impacts, data availability limitations, and other project-specific limitations that severely affected performance. We will present high-level data and correlation analyses and a plan for accounting for COVID impacts for PCEC robotic science mission cost data normalization.

Based on feedback from PCEC users and more experience using PCEC v2.3 for robotic science missions, two areas for improvement are under investigation. These areas include improving estimating performance for flagship missions and for System Integration & Test. Multiple options are being assessed to improve estimates for NASA's flagship missions. These options include derivation of tuning factors that could be used with the PCEC v2.3 CERs or the development of new CERs tailored for flagship missions. Higher-than-expected System Integration & Test estimates have been noted by multiple model users. Data used to support this CER is under further assessment and potential CER replacement candidates are in development. We will share results from preliminary analyses of alternative approaches for flagship missions and System Integration & Test.

In addition to these two topics, our presentation will also provide a summary status update on the tool, updated capabilities that are under development for the next major release, and the status of the development of a formal PCEC training course.

28_ PP&C Improvement at MSFC

Authors: Andy Prince

Presenters: Andy Prince

Abstract: MSFC has established a dedicated PP&C organization within the Office of Strategic Analysis and Communications (OSAC). This new organization brings together cost, schedule, EVM, and PP&C generalists for the purpose of advancing PP&C at MSFC. The new PP&C Office combines legacy functions, such as training, schedule analysis, and cost estimating, with the mandate to lead PP&C stewardship. As the PP&C stewards we are focused on creating a greater awareness of the importance of PP&C

to program and project success, as well as developing future PP&C leaders who are well-rounded, knowledgeable, and experienced.

The presentation will focus on the changes in organization and on the initiatives underway to improve PP&C at MSFC.

30_ Post Launch Testing Sequence of Events. A day-to-day project schedule

Authors: Denis Pinha, Rodolfo Lavaque

Presenters: Denis Pinha, Rodolfo Lavaque

Abstract: Missions at NASA follow best practice of project management and systems engineering.

A key component of project management at NASA deals with scheduling of tasks which must fulfill conceptual, technical and mission requirements.

The challenge of scheduling tasks can vary during the mission-life cycle depending upon the level of detailed required, time frame, and how often re-planning is needed. Long term scheduling assumes a relative more stable system which priorities, and other constraints do not change often during the scheduling period. However, scheduling tasks that focuses on short term, that is, scheduling on an hourly, daily, or weekly basis assumes much less stable system. This work deals with short term scheduling that requires a more often re-planning activities where priorities, and other constraints change over time.

A case study and lessons learned on how to design and plan the Post-Lauch Testing Sequence of Events (PLT SOE) for GOES-R series satellite are described to illustrate this problem.

31_ CADRe 2022

Authors: Eric Plumer

Presenters: Eric Plumer

Abstract: Overview of current CADRe initiatives.

32_ Math is Hard

Authors: Rachel Sholder, Sally Whitley

Presenters: Rachel Sholder

Abstract: The NASA cost community relies on risk analyses to estimate confidence in a project's budget. At PDR, convention requires that baseline cost/schedule confidence should be around the 50th percentile and cost plus reserves should be around the 70th percentile of the joint distribution of total cost and schedule. But how can we test whether our approach to determining 50th and 70th percentiles for missions going into PDR is reliable? According to cost actuals from historical NASA missions, there is an 88% chance that a mission will overrun its planned budget. There is a 50% probability that a mission will outspend its budget by 16% or more. At the empirical 70th percentile, NASA missions are spending their full budgets plus 30%. Our research will examine the NASA cost community's approach to reserve postures. Using the empirical dataset as our guide, how can projects approaching PDR provide cost and schedule analysis that supports the goal of achieving 70% confidence in the budget at the portfolio level?

33_ Using Automation to Lighten your Load

Authors: Erin Wood & Danelle Fogle

Presenters: Erin Wood

Abstract: Over the course of the past 2 years, various methods have been implemented at Glenn Research Center in efforts to identify and automate touch points within our projects & programs, within other centers and other departments within our center, and with our outside contractor schedules. Touch points can be identified as the hand-offs, or external predecessor/successor relationships between projects necessary to get the job done. Successful coordination within high priority projects in which lab and resource availability is competitive is often vital.

Benefits of this technique include:

*High customer service by providing both the information and the impact to the project and program management instantly

*a substantial reduction in manual data mining for summary graphics and integrated reporting

*the ability to isolate metrics within Acumen Fuse to more easily identify 'trouble spots'

*Greater ability to provide proactive data-driven decision-making information to stay ahead of the fire instead of spending time putting it out

*Reducing required communication between departments. Automated integration means independent schedules can 'talk' to each other without being disruptive to the daily flow, instead of that one more email, phone call, and meeting to coordinate the exchange of information

It cannot work without the right programming and human touch though. This presentation will explain exactly how-to, mistakes that we've made so far, other strategies that didn't work as well and why, and how to identify these touch-points before they become your future headache.

In addition to learning the technique, also learn quantitative information on implementation. How much time does it take to set up in a real-world environment, what buy-in challenges have we experienced thus far, and how much time will it save on a regular basis. Is the small amount of headache and set up work worth it? We'll give you all the information to decide for yourself.

34_ Aerospace Viewer of NASA Project Staffing Data (aView): A Practical Tool for Analyzing Staffing Levels and Cost Across Missions

Authors: Sarah Lang, Justin McNeill, Jr., Tommy Tran, Alexander Zarate Garcia, C. Jason Zhang

Presenters: Sarah Lang

Abstract: The Aerospace Viewer of NASA Project Staffing Data (aView) team will present a summary of updates made to aView since 2020. Built upon the FTE Tool first released in 2011, aView is a repository of programmatic data used for comparative analysis of staffing profiles of NASA science missions. It provides high-level views of the historical data of NASA planetary missions for development Phases C and D as well as the operations Phase E of Full-time Equivalents and Work Year Equivalents (FTE/WYE). It can be beneficial using aView when reviewing and evaluating the basis of estimate for mission phases to understand how the labor basis of estimate compares with past NASA missions. aView was developed by The Aerospace Corporation for the benefit of the

NASA Planetary Missions Program Office. It is a web browser-based application and will be available via the One NASA Cost Engineering (ONCE) model portal.

35_ Integrating Architecture, Programmatic, and Affordability Viewpoints: The Programmatic Cost Tool (PCT)

Authors: Joe Mrozinski, Robert Shishko

Presenters: Joe Mrozinski

Abstract: The Programmatic Cost Tool (PCT) is a software package which provides a framework to produce affordability assessments and perform trades for complex spaceflight architectures, such as multi-system, multi-decade Human Moon-to-Mars Program architectures. This talk will build upon our 2018 NASA Cost and Schedule Symposium slide presentation by providing a live demonstration of the tool, as well as many of the new features added in the past 4 years.

PCT INPUTS:

While the architectures analyzed using PCT are grandiose in scale, usually billions of dollars spread over decades, the inputs PCT requires are fairly straightforward. The user need only provide information for three tables:

- A table of Systems, such as launch vehicles and flight elements, and the corresponding programmatic details for each, such as development, production and operations costs and schedules. Thumbnails representing each system, if provided by the user, are fed downstream to make certain GUIs and outputs more readable.

- A table of Flight Types, where each flight type is simply a combination of systems which would be part of a single launch manifest.

- A table of Flights, which defines the date and number of launches for all Flight Types.

PCT OUTPUTS:

Armed with these three tables, as well as with a user-supplied budget profile, PCT then provides the following outputs:

- Summary tables of the total dollars needed per system for Development, Production and Operations, as well as the total of all three, on an annual basis.

- A timeline showing each required systems Development, Production and Operations schedules durations required to enable the architecture.

- A "sand-chart" showing the total cost of the architecture by year as compared to the yearly budget. The different sand layers can represent individual systems, or those systems can be grouped in user-defined ways, such as by NASA center.

- A "dance card" showing the year-to-year flights and their corresponding systems. This allows the user to quickly see the "bigger picture" of the architectures, allowing for easy verification that the architecture represented is as expected. The display

also allows the user to come up with trades should the current architecture iteration be in violation of the budget profile.

PCT resides in an easy to use Excel file, making it intuitive to interact with. PCT has been developed with support from both the Jet Propulsion Laboratory and the Johnson Space Center.

36_NICM Version 10

Authors: Joe Mrozinski, Luther Beegle , Kyle Brown , Robert Cesarone, Michael DiNicola, Michael Fong, Melissa Hooke, Alfred Nash, Sherry Stukes

Presenters: Joe Mrozinski

Abstract: The NASA Instrument Cost Model Team announces NICM Version 10 will be released in the Fall of 2022. Several of the upcoming upgrades will be discussed and/or demonstrated, including: 1) A new repeatable, analytic solution in both the System and Subsystem Tools, 2) Isoquants introduced to the JCL plots, 3) Bayesian imputation improved with boundary conditions, 4) K a new Nearest Neighbors weighted average tool added to the NICM Search Engine Outputs, 5) Expanded Search Engine capabilities and summaries, 6) and more!

37_ Mission Operations Cost Estimation Tool (MOCET) Research and Status Update

Authors: Marc Hayhurst, Brian Wood, Cindy Daniels, Lissa Jordin,Washito Sasamoto, Waldo Rodriguez

Presenters: Marc Hayhurst

Abstract: The Mission Operations Cost Estimation Tool (MOCET) team will present an overview of recent research topics as well as the latest mission updates. Research topics this year are focused on continued study & refinement of level 2 Work Breakdown Structure (WBS) modeling, and modeling for extended missions cost. An overview of the state of the user community will be presented including statistics from the One NASA Cost Engineering (ONCE) model portal and *software.nasa.gov*. MOCET is a model developed by the Aerospace Corporation in partnership with NASA's Science Office for Mission Assessments (SOMA), which provides the capability to generate cost estimates for the operational, or Phase E, portion of NASA science missions. MOCET is comprised of CERs that have been derived from historical data for Planetary, Earth Science, and Explorer missions. The resulting CERs and accompanying documentation have been implemented as a standalone Excel based tool which is now available via the One NASA Cost Engineering (ONCE) model portal and *software.nasa.gov*.

38_ Electrified Aircraft Propulsion Economics

Authors: Peter Frederic

Presenters: Peter Frederic

Abstract: Tecolote Research recently participated in a design exploration study conducted by NASA's Advanced Air Transport Technology (AATT) project focused on regional transport aircraft concepts employing electrified aircraft propulsion (EAP). NASA's interest in EAP aircraft concepts stems from the potential to reduce fuel consumption, emissions, noise, and operating costs.

We selected direct operating cost plus interest (DOC+I) as the primary economic figure of merit used to assess the EAP concepts. DOC+I relates directly to profitability for aircraft operators (given market-driven ticket prices). DOC+I includes the following elements: aircraft ownership, energy, maintenance, flight crew, and flight equipment financing (the "+I" in DOC+I).

DOC+I analysis was based on a tool called the Probabilistic Technology Investment Ranking System (PTIRS). PTIRS is a business case model for evaluating emerging technologies in the context of commercial aircraft development, manufacturing, and operations.

This was a comparative cost study. The economic impacts of EAP were assessed by comparing estimated DOC+I for enhanced aircraft employing EAP versus estimated DOC+I for corresponding baseline aircraft not employing EAP. The study focused on regional class aircraft because conventional wisdom and prior studies suggested that regional class EAP transports may see larger benefits for a given battery technology level than single-aisle or larger aircraft. We modelled five specific regional aircraft configurations: 18 Passenger Turboprop, 48 Passenger Turboprop, 70 Passenger Turboprop, 50 Passenger Turbofan, and 78 Passenger Turbofan.

Each aircraft configuration was based on an actual historical aircraft. Actual cost and technical data the historical was used to calibrate the engineering sizing and cost models used in the study. The aircraft were then brought up to a modern state-of-art baseline by assuming technology improvements from each aircraft's entry-into-service to the year 2020. The baseline aircraft were then updated with EAP technologies and resized to produce the EAP aircraft. Several technology-enhanced cases were considered for each configuration, trading battery size, battery specific energy, electric motor size, and hybrid power split. We also performed sensitivity cases to explore the impact of changes in jet fuel cost and ground-supplied electrical energy cost.

This study showed that overcoming the additional cost and weight associated with the EAP systems will be very challenging if EAP aircraft are to be economically competitive with conventional aircraft. This paper will highlight the challenges identified.

39_ Beyond the Box: Utilization of Underlying JACS Simulation Results for Advanced SRA and JCL analysis

Authors: Steve Wilson, Mike Stelly

Presenters: Steve Wilson

Abstract: Tecolote Research maintains its widely utilized JACS add-on to Microsoft Project that facilitates a suite of analyses involving stochastic cost, schedule, and risk simulation, such as Schedule Risk Analysis (SRA) and Joint Confidence Level (JCL) analysis. A prominent feature of JACS is its native expression of measures and visuals associated with these analyses, but underlying them is a massive register of the integrated simulation results called the cache file, which includes per iteration information for model elements. Transforming the data in this file (using a data processing tool) and injecting it into a data visualization tool enables special sophistication in SRA/JCL analysis not previously enjoyed by the NASA community.

In this paper, we will discuss our exploration of the cache file along these dimensions:

- Simulation results processing, including tool choice (e.g. R or Python), transformations, pivots, joins, cleaning, output structure options, and computational constraints

- Task-based analysis, including critical path identification, perspectives on criticality measures, and driver identification

- Risk-based analysis, including various methods of conditional analysis, stochastic omissions, the importance of the role of parallelism and compensatory risk analysis strategies, visualizations, and interpretation of risk-based results and measures

- Integrated cost and schedule analysis

This paper marks the beginning of a new effort by our JSC team to advance the frontier of integrated programmatic analysis. Future papers in this series will reflect updates to this project, rendering more discoveries and examples.

40_ Human Spaceflight Schedule Study & Database

Authors: Steve Wilson, Ashley Varma

Presenters: Steve Wilson

Abstract: The rise of human spaceflight (HSF) activity attributable to the advent of the Artemis campaign, commercial enterprises, and international partnerships demands a crisp, contextual understanding of programmatic history as NASA continues to sharpen its assessment and forecasting capability. The success of HSF projects will depend upon, in large part, proper appreciation of the complete human space story, which, for now, remains riddled with ambiguity and omissions. Though contributions from CADRe and other ongoing data collection work have been significant, HSF lacks a definitive source for accurate, high-resolution, and ready-to-use schedule data that captures all major legacy projects and precursors.

Investigating this issue, we found that some of the quoted schedule data points and Rules-of-Thumb (RoT) used in programmatic analysis around the agency and domestic space community often lack citations or proper historical interpretation. In fact, some datasets contradict one another or amount to viral reproductions of previously flawed sets that have been circulating through back-channel networks for decades.

In this paper, we will discuss our nascent solution to this longstanding issue: The Human Spaceflight Schedule Database, a compendium of over 2300 authoritative, meticulously documented data points spanning the full scope of HSF history. We will show several cuts of these data and share new Rules-of-Thumb at various levels:

- Total DDTE duration: ATP thru hardware delivery & launch

- X Category: Hardware type, programmatic era, crewed systems, commercial development, etc.

- X Milestone: ATP, PDR, CDR, delivery, and launch

- X Growth: Total, over time and between milestones

- X Analysis: Select SRA s-curves (some over time) vs actual dates of milestones they forecast

This paper marks the beginning of a new effort by our JSC team to compile historical technical, cost, schedule, and risk (TCSR) data into our HSF Body of Knowledge. Future papers in this series will reflect updates to this project, rendering more analyses and RoT.

41_ ARES Schedule Integration Tool - Integrating Artemis Schedules

Authors: Mark Miller

Presenters: Mark Miller

Abstract: Major endeavors like the Artemis Program require the coordination of many centers, project organizations, programs, directorates, contracts, and support groups. The main challenge for these groups is the integration of a lot of people, what they are supposed to do and when they are supposed to get it done. Often this integration is just as complex as the hardware and software systems being developed. Although a great deal of effort goes into the development of detailed requirements and configuration control of the hardware and software end items, not so much goes into the development, configuration management, control of clear integrated schedules. In addition, schedule integration in large projects suffers from such things as poorly understood interdependencies, loose control over implementation level schedules, lack of illustrated products for teams, lack of a common share location for those products, and frequent confusion over top level milestones and the lack of accompanying meta data, criteria and assumptions. We will demonstrate the ARES Schedule Integration Tool and Integration web site that provides program and project teams access to a quick schedule development, data integration, automation and illustration tool set, an integrated method to perform data and meta data capture, and an integrated cloud web platform for sharing data instantly. With this schedule integration capability teams at all levels can configuration manage and control their schedule data and the data they provide to their customers.

The ARES Schedule Integration Tool (ASIT) provides a framework that allows individuals and teams to quickly build and maintain visual schedule products consisting of shared task and milestone data with low operational impact. Several key innovations were involved such as creating data-driven graphics, using a distributed team to identify and manage schedule information as they normally perform their work using an easy-to-use tool to integrate and share key pieces of information. The tool ensures that data is normalized and can easily be made available to any interested peers, interface organizations, management, or customers through an integrated online library. Using the same tool set any group or individual with access to the system can reference that data, add logic that applies to them, and add their own data to create composite schedules. Custom data can then also be published.

The ASIT Web Site provides a single location to find toolset information, an API (Application Programming Interface) for real-time data exchange between ASIT powered tools and other systems, administrative pages for teams to perform their own schedule configuration management tasks, and an online catalog of

published items to all NASA organizations. Built on NASA's new cloud services, the ASIT web site allows teams across the Enterprise to easily find information about schedule integration, learn about tools to build products and connect to the catalog, and find the data from other organizations they need to integrate with their schedules.

(ASIT web site: https://asit.nasa.gov,

NAMS requests: https://namssupport.nasa.gov/nams/asset/264204/994530422)

42_ Applying Schedule Uncertainty in JCLs – Problems and Solutions

Authors: Matt Blocker

Presenters: Matt Blocker

Abstract: The quality of a schedule risk analysis, both by itself and as part of a JCL model, depends on the inputs for uncertainty. Even relatively simple schedules are so complex that it's difficult to visualize the relationship between uncertainty inputs and results. Schedules are often unique, with differences between projects, organizations, and even individual schedulers. This complexity and lack of standardization complicates uncertainty analysis and makes it difficult to develop common rules or guidance for developing uncertainty inputs.

This presentation's goal is to identify several potential issues and demonstrate potential approaches that eliminate or mitigate them. Perhaps most importantly is the fundamental disconnect between a schedule's level of detail, and associated uncertainty inputs, and any available data for constructing distributions. Modelers (author included) have often accepted this disconnect as inevitable and tried to minimize it by reducing the schedule to be more directly in line with the inputs or adjust the lower-level inputs to more reliably reflect the higher-level analysis. This issue can be addressed with a factors-based approach that more accurately models the data while still allowing the individuality of the schedule to influence the results. This approach is easy to apply and provides a more predictable link between input and output. It logically simplifies the uncertainty inputs without sacrificing the more complex logic of the schedule.

Another issue includes the tendency for schedule risk analysis results to have unexpectedly low variability. This presentation discusses what drives this, ways to mitigate harmfully low variability, and also observations on what expectations make sense for a schedule model. Given NASA's JCL policy there are certain expectations for a model that are reasonable, while the nature of the models and the types of distributions used as inputs drives certain limitations. There are some modeling suggestions that may help the models better capture the spirit of the JCL policy.

These techniques have been successfully applied in JCLs at GSFC with benefits to the apparent quality of the results, ease of communication, and predictably of the model.

43_ ASCoT/ONSET

Authors: Sam Fleischer, Jairus Hihn, and James Johnson

Presenters: Sam Fleischer

Abstract: Here we provide an overview of the new features and model updates in the

upcoming release of the NASA Analogy Software Cost Tool (ASCoT). ASCoT, hosted within the Online NASA Space Estimation Tools (ONSET) on the One NASA Cost Engineering (ONCE) Database, is a web-based tool that provides a suite of estimation tools to support early lifecycle NASA flight software cost analysis. In addition to the traditional parametric flight software costing method COCOMO II, ASCoT contains a Bayesian linear regression (CER) to predict a probability distribution of total flight software development cost as a function of total spacecraft cost, as well as four analogic methods: k-Nearest Neighbors (kNN) and Clustering models to predict Effort (in work-months) and total source line of code (SLOC). These methods are designed to work primarily with system-level inputs such as mission type (orbiter, lander, etc.), mission destination (Earth, Inner Planetary, etc.), and the number of instruments and deployables. Nonlinear principal components analysis is performed to find the principal features of the data composted of both categorical and numerical variables and is necessary prior to defining our analogic methods. Sensitivity analyses and in- and out-of-sample model performance results are presented for the Bayesian CER and the analogic methods.

44_ Bayesian Rules of Thumb

Authors: Sam Fleischer and Melissa Hooke

Presenters: Sam Fleischer and Melissa Hooke

Abstract: Cost Rules of Thumb are critical is estimating cost during early phases of project formulation. These Rules of Thumb typically take the form of a sequence of percentages over which a total cost is allocated across NASA WBS elements. Rules of Thumb can then be used to extrapolate cost from one or more known WBS elements to the remaining unknown WBS elements, assisting early project formulation architecture studies (such as those in JPL's Team X and A Team).

A number of issues can arise when generating and using cost Rules of Thumb. For example, many records of project costs consist of incomplete data. Typical methods of dealing with incomplete cost allocation data include (a) ignoring missions with incomplete data, or (b) taking averages of the non-zero percentages across missions, but both of these methods can result in biased estimates if there are few data, or if the existence of incomplete data correlates with total mission cost or any particular WBS element. Another common example is cost reported in one or more incorrect WBS elements. This is especially prevalent in smaller missions where it is more common for engineers to perform tasks that fall under the purview of multiple WBS elements.

Furthermore, a Rule of Thumb estimate is typically reported as a point estimate; there is no reported uncertainty around the percentages used to generate an allocation. Even in the rare case in which confidence intervals around mean percentages are provided, there may be positive or negative correlations between WBS elements which can skew estimates.

Here we attempt to address these problems by formulating probabilistic Rules of Thumb using the Dirichlet distribution, in which a distribution of allocation schemes, rather than a single allocation scheme, is generated. We use a bootstrap imputation method to simultaneously account for uncertainty in the missing data

while using all available information contained in the dataset. The imputed datasets are then input into a Bayesian model which accounts for correlations between WBS elements and properly accounts for uncertainty in the final Rule of Thumb percentages and predictions. We describe the mathematical model, its priors, and provide snippets of R code utilizing the brms (Bayesian Regression Models using Stan) package. To illustrate this model, we generate a Bayesian Level 2 WBS Cost Rule of Thumb for MIDEX (Medium-Class Explorers) missions with data extracted from NASA's CADRe. We then compare this method's performance with the classical Rule of Thumb method.

45_ ONCE Database and Data Protection

Authors: James Johnson, Eric Plumer, Julie McAfee, and Mike Blandford

Presenters: James Johnson

Abstract: The One NASA Cost Engineering database (ONCE) provides vital data on NASA projects to a community of over 600 users that includes NASA Civil Servants, Contractors, FFRDCs/UARCs, and others. The data contained in the ONCE database comes from the official NASA Cost Analysis Data Requirements (CADRe) which includes a variety of important technical and programmatic information on projects and programs. This sensitive data is protected by multiple layers of security and auditing that ensure controlled access to verified users. Although ONCE provides data to diverse community, not all organizations and individuals can become verified users due to data protection requirements. In addition, all ONCE users must agree to terms and conditions when creating an account that emphasize the need to protect and limit the distribution and usage of the data. Recently, NASA and the Federal Government have implemented "CUI" or Controlled Unclassified Information standards that have impacted the data protection requirements for ONCE and CADRe. This presentation will provide an overview of the updates to the ONCE database, a detailed discussion on user responsibilities when accessing data, and provide the results of incorporating the new CUI standards.

46_ Aerospace CubeSat Cost Estimation Tool (ACCET)

Authors: Shirin Eftekharzadeh, Nichols F. Brown, Jacob Sabol, Manuel E. Puyana, Angela M. Vu, Amy P. Macrina

Presenters: Jacob Sabol

Abstract: The Aerospace CubeSat Cost Estimating Tool (ACCET) is a parametric model developed by the Aerospace Corporation to predict the development cost of CubeSats. The underlying methodology for ACCET is Cost Estimating Relationships (CERs) that are derived based upon actual historical cost and technical data for the CubeSat missions. The CERs in this model are functions of simple, objective technical variables. CER development was enabled by two key approaches. The first key is the normalization of cost across all missions to a first unit satellite development cost. The second key approach is the separation of technology demonstration missions from operational/science missions. This paper will present an overview of the dataset, the normalization approach for cost, and the rational for CubeSat categorization. The underlying statistical approach to develop the ACCET CERs will also be discussed.

47_ Outstanding in Your MS Project Fields

Authors: William G. Paradis

Presenters: William G. Paradis

Abstract: Have you ever wondered about all those available field offerings in MS Project? We sometimes get so wrapped up in the general use fields that it becomes overwhelming to see the long list of available fields when inserting field columns when using the tool. It's almost a relief when we see the fields that we are looking for; you know "Start", "Finish", "Duration", "% Complete", "Text Fields"; the general schedule fields. As you know there is so much more. So much more in fact that there are 427 available fields built into MS Project and it's worth the time to explore these available fields and see how they can make you more outstanding in your field. I prepared a stimulating presentation and would like to share it with the broader NASA Cost and Schedule community; this process really helped me understand MS Project more and I hope it does the same for you; I hope to see you there.

49_ The Integrated Baseline Review (IBR) – Why Are They Needed

Authors: Nick Frazier, Brad Richards, Chris Sadler

Presenters: Nick Frazier, Brad Richards, Chris Sadler

Abstract: The Earned Value Management community purports that the Integrated Baseline Reviews (IBRs) are a critical part of the integrated program management process. Are IBRs that critical? What do IBRs reveal? A study of NASA IBR Findings, an analysis of over 40 IBRs that were conducted over a period spanning two decades, was conducted to see what IBRs reveal and to look for any recurring themes.

The IBR is a risk-based review conducted to ensure a mutual understanding between the customer and supplier of the inherent risks in the supplier's Performance Measurement Baseline (PMB). A secondary, but equally important purpose is to ensure the PMB is realistic for accomplishing all the authorized work within the authorized schedule and budget across the five risk areas of technical, cost, schedule, resources, and management processes.

This session will provide background information on IBRs, the type of data that is revealed during the conduct of an IBR, an insight to the recurring findings that our analysis found to be revealed during this type of review, and some potential solutions to these recurring findings.

50_ Applying Data to Improve Schedule Analysis

Authors: Ivan Bembers, Siemone Cerase, Tony Claridge, Michelle Jones

Presenters: Ivan Bembers, Siemone Cerase, Tony Claridge, Michelle Jones

Abstract: The National Reconnaissance Office analyzes monthly cost and schedule data for acquisition programs and maintains a central repository of historical information. The Cost and Acquisition Assessment Group has been conducting research on program performance to improve schedule analysis by better understanding schedule variance, program recovery and milestone delivery.

This briefing will share results of completed studies:

- Data driven duration uncertainty parameters to improve schedule risk assessment

- Schedule Execution Metric Thresholds for data driven predictive analysis

- Benchmarking with a Schedule Estimating Relationship

- Conclusions form Phase 1 Schedule Margin Study

51_ Earned Value Management and Schedule Management

Authors: Barbara Phillips, Joe Fischetti

Presenters: Barbara Phillips, Joe Fischetti

Abstract: The objective of EVMS surveillance is to ensure that the management control processes that support the performance measurement baseline (PMB) are in place, compliant with the EVMS guidelines, are routinely being used, and provide timely and reliable data. The PMB is a triple constraint where the constraints are schedule, budget and scope.

For Surveillance, NASA uses the DCMA EVM Compliance Metrics (DECM) Tests that are aligned with the EIA-748 EVM Standard. Guidelines 6 is Scheduling Work, and DECM has 23 Tests for evaluating if the IMS supports project goals in its planning, statusing and forecasting.

This session will focus on the Test Metric that analyzes forecast start/finish dates riding the status date of the IMS for two or more consecutive months as an example of how surveillance works in concert with IMS health checks. It will cover how to run the test to recognize trends and how this test helps ensure that the forecast is credible in support of critical path analysis.